World Crisis in AGRICULTURE

nly 10% of Earth's land
urface is under cultivation.

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World Crisis in AGRICULTURE

by Dale Schurter and Eugene Walter

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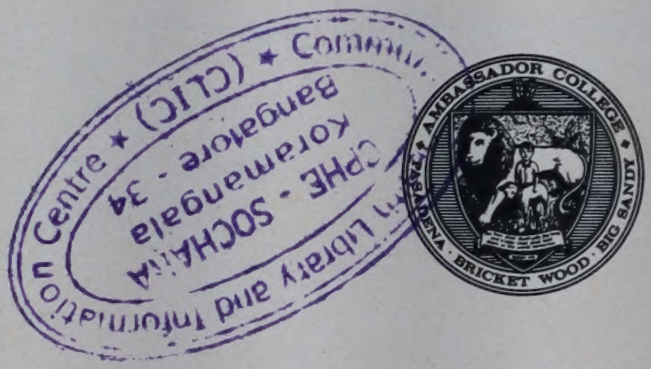

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Government leaders worldwide have come face-to-face with a dangerous — yet little understood — crisis in agriculture. Today farmlands are tired, overworked, depleted. Modern methods of farming are producing a more critical soil imbalance.

WHY do we have this agricultural CRISIS?

Where is it leading — and what is the solution?

NOW FAST SHAPING UP—

WORLD CRISIS in AGRICULTURE

TODAY *agriculture is in deep trouble.*

It is facing a crisis which even now is affecting the cost and the quality of the food on your dinner table.

It is easy to see that widespread disease and famine loom on the horizon for the poor, "have-not" areas of the world. But few are aware that an agricultural crisis of equal — and possibly *greater* — magnitude is in prospect for that third of the world we call the "have" nations.

We in the United States, Canada, Western Europe, Australia, South Africa and the other "have" areas of the world are dazzled by the storybook pronouncements of "scientific agriculture." We have become so accustomed to talk about "burdensome surpluses" that we seem to believe we are immune to a food crisis.

But in the very near future, the growing crisis in agriculture could easily cause YOU to be numbered among the seriously sick and diseased — or among those hapless millions who go to bed at night with empty, aching stomachs.

Seven Inches from Starvation!

No matter who you are or where you live, you must eat food to continue your physical existence. Ultimately

Bob Taylor Photo

ALL your food comes directly or indirectly from the soil and, more specifically, from the top few inches of earth known as topsoil.

This life-sustaining topsoil lies in a thin layer at an average depth of seven or eight inches over the face of the land. In some few areas it may be as deep as two feet or more; in many other areas it is considerably *less* than seven or eight inches.

"If that layer of topsoil could be represented on a 24-inch globe it would be as a film three millionths of one inch thick. That thin film is all that stands between man and extinction" (Mickey, *Man and the Soil*, pp. 17-18).

This thin layer of earth sustains ALL PLANT, ANIMAL AND HUMAN LIFE!

Previous civilizations have already destroyed much of it, and today we are depleting and destroying that which remains at a faster rate than at any previous time in human history.

Look for a moment at what man has done to the soil.

The Record of History

The valleys of the Tigris and Euphrates supported some of the greatest civilizations of old. A great irrigation complex was based on these rivers. These rich lands were the granary of the great Babylonian Empire. Pliny, the Roman naturalist and writer, tells of harvesting two annual crops of grain on this land and grazing sheep on the land between crops.

Today, less than 20 percent of the land in modern Iraq — site of these two famous valleys — is cultivated. The landscape is dotted with mounds representing forgotten towns, the ancient irrigation works are filled with silt (the end product of the oldest and biggest polluter in history, soil erosion), and the ancient seaport of Ur is now 150 miles from the sea, with its old buildings buried under as much as 35 feet of silt.

Similar conditions exist in Iran, once the seat of the great Persian Empire.

The valley of the Nile was another cradle of civilization. Every year the river overflowed its banks at a predictable time, bringing water to the land and depositing a layer of silt rich in mineral nutrients for plants. Crops could be grown for seven months each year, and extensive irrigation systems were established by 2000 B. C. This land was the granary of the Roman Empire, and this system of agriculture flourished for another 2,000 years.

But the population has continued to grow, and economic considerations have diverted land from growing food to growing cash crops.

Then in 1902 a dam was built at Aswan to prevent the spring flood and to permit year-round irrigation. Since then the soils have been deteriorating through salinization and productivity has decreased. The new Aswan high dam is designed to bring hundreds of thousands of new acres under irrigation. But the dam is proving to be a disaster for Egypt. Any plusses accorded the dam are far outweighed by the creation of serious problems. The dam could become the ultimate disaster for Egypt. Aside from *salinization,* population growth has virtually outstripped any possibility that the new agricultural land can raise the average level of nutrition.

The Sahara Desert was once forested and inhabited. The glories of ancient Mali and Ghana in West Africa were legends in Medieval Europe. Ancient Greece had forested hills, ample water, and productive soils.

In Lebanon the old Roman roads, which have prevented erosion of the soil beneath them, now stand several feet above the desert floor. In a churchyard protected from goats for 300 years, cedars were found in 1940 to be flourishing as in ancient times.

"In China the evidence is plainer. The Chinese had one of the greatest and earliest of civilizations. Today

they are a poverty-stricken, and helpless people. Tens of millions of them are crowded into flat muddy valleys and other millions of them huddle in houseboats on rivers which run yellow with soil from their hillsides" (*Soil Erosion Control,* Burges, pp. 1-2).

Few worse-eroded regions exist in the world than that of Northwest China. The channel on the Yellow River is choked with silt and its floods are catastrophic.

Ancient irrigation systems of India and China stand abandoned and filled with silt. Dr. Lamont C. Cole told a symposium sponsored by the American Association for the Advancement of Science, "When the British assumed the rule of India two centuries ago the population was about 60 million. Today it is about 500 million and most of its land problems have been created in the past century through deforestation and plowing and the resulting erosion and siltation, all stemming from efforts to support this fantastic population growth."

Speaking of Central and South America, Dr. Cole said, "Archaeologists have long wondered how the Mayas managed to support what was obviously a high civilization on the now-unproductive soils of Guatemala and Yucatan. Evidently they exploited their land as intensively as possible until both its fertility and their civilization collapsed. In parts of Mexico the water table has fallen so that towns originally located to take advantage of superior springs now must carry in water from distant sites. . . . Aerial reconnaissance has revealed ancient ridged fields on flood plains, the remnants of a specialized system of agriculture that physically reshaped large parts of the South American continent."

Today we call these areas of the world underdeveloped. We ought to call them *over*developed!

The Lesson of Rome

Although the record is not complete, more is known about the progress of soil depletion in the Roman

Empire than in the ancient civilizations of western Asia. What is known makes an invaluable case history.

The soils of Italy started to decline before the reign of Augustus (called the golden age of Rome), and by the time of the fall of the Western Empire, some 500 years later, the soils not only of Italy but of all the provinces except Egypt were completely exhausted. In England evidences of Roman cultivation have been found, in places, five feet below the present surface.

Largely as a result of Roman exploitation, there are today no forests on the Mediterranean coast from Spain to Palestine. Typical of this region is the North Dalmatian coast where the hills were once magnificently clothed with primeval forests. The Romans and the Illyrians, the earliest inhabitants, began the destruction of the forests. The first Slav settlers were prodigal, too. The denudation of the hills was completed by the Venetians, from about 1400 to 1700, who cut the trees for timber for their ships and pilings for their palaces. The Yugoslav government was unable to reforest the hills, because the young trees not uprooted by the savage north winds of winter were eaten by the goats of the peasants.

Before the fall of the Western Roman Empire in 476 A.D., the agricultural regions of Italy and the provinces were nearly depopulated. The exhausted, eroded soil simply could not support the population and the terrific weight of imperial taxation.

Until modern times the world had never known a more exhausting exploitation of both man and soil than that of the Roman Empire. As we have just seen, the results of Rome's avarice are visible yet today in the eroded hills of Greece and the Mediterranean coast, in the sands of North Africa and western Asia.

Yet thirty years ago Kellog reported that some soils in Italy had completely recovered and were producing more than they ever did. Also, some soils in Central Europe and England have been farmed for centuries not only without injury, but with yields steadily increasing

for the past 150 years (*The Soils that Support Us*, p. 269).

WHY? How did this recovery come about? And why is it that the soils of Central Europe and England have not suffered erosion comparable to that of other areas?

The Golden Age of Abundance

Following Rome's self-destruction, Europe in the Middle Ages was always on the verge of starvation. No progress was made in maintaining soil fertility.

During the 18th century, Central Europe's soils were showing severe deterioration.

But since the end of the Napoleonic Wars, the world has had a larger food supply than it ever had before. The 19th century was the golden age of abundance.

Except for this relatively brief period, food has been man's chief preoccupation throughout history. Now this age of abundance is rapidly drawing to a close. Already two thirds to three fourths of the human race are again underfed and undernourished.

Two factors made the 19th century an era of spectacular abundance of food. While Europe was undergoing an industrial revolution, it is often overlooked that it was simultaneously undergoing an *agricultural* revolution.

Substitution of grasses and legumes for bare fallow, contour cultivation and good crop rotations were three important conservation practices which were adopted. Further, agriculture shifted from a soil-depleting grain economy to a soil-building livestock economy. Devoting large acreages to permanent, improved pasturage not only greatly increased Europe's food production, but gave an unparalleled stability to her soils — a stability maintained despite two world wars. This stabilization was aided by the fact that soils in Central Europe are generally heavy and not as easily erodible. Also, the rainfall is regular, frequent, and gentle, as contrasted

with the heavier and more irregular rains that prevail in most parts of the U. S.

But there is also this most important fact which must be considered: SOIL STABILITY IN EUROPE WAS PURCHASED AT THE EXPENSE OF THE RUTHLESS EXPLOITATION OF THE SOIL IN THE NEW WORLD. The dramatic agricultural revolution which fed the new European masses fathered by the machine age was important. But even more important was the European colonization of the rich new fertile lands — the Americas, Africa and Australia — and the opening up of the black lands of Russia.

This colonization took place coincidentally with the perfecting of machine exploitation of the soil and with the development of rail and ocean transport of food crops to the ends of the earth.

With this combination of machine tillage and rapid transport, the vast new lands became the granary of the world. Their produce could be moved quickly to feed the swiftly growing industrial populations of the capitalist countries or to alleviate famine in India or China.

The soils and resources of the new frontiers — and especially North America — *seemed* inexhaustible. But not for long!

The Last Frontier

Shamefully the New World had been exploited and abused. The white settlers had scarcely set foot on the North American continent before the menace of soil sacrifice appeared. By 1685, streams muddy with silt were seen, and increased floods, due to cutting down the forests, were observed. Undaunted, the destruction of field and forest continued.

Washington and Jefferson — among a host of other early American leaders — were alarmed by what they saw taking place around them. They crusaded against destructive farming practices in word and deed, but to no avail. The rape of the New World continued — and

accelerated. When one tract of land wore out, new land was always available just a little to the west.

"Every social and economic force seemed to encourage the spread of American agriculture. The invention of McCormick's reaper, in 1831, and the other inventions of farm machinery that followed it, made possible the cultivation of more and more acres. When the iron plow proved inefficient in the sticky prairie soil, the self-scouring steel plow appeared in 1837 to accelerate the westward march of agriculture" (*Man and the Soil*, p. 46).

Some few, such as Marsh, a Vermont lawyer and scholar, wrote with the ringing tones of a prophet, warning that the way man was going was "as to threaten the depravation, barbarism, and perhaps even extinction of the species" (*The Earth as Modified by Human Action*, p. 43). But all such warnings were ignored.

The close of the nineteenth century saw the Oklahoma territory opened to farmers. It was the last great area of restricted public farmland. Until this point in history access to free land had been the safety valve which had relieved the pressure of unemployment and economic distress.

Now all this was about to change. Throughout history, when man had worn out land in one area, he had moved to another. Now, for the first time, there was no rich new agricultural land to which man could go. The last significant frontier in the U. S. had been reached!

Decades of Destruction

The effect of reaching this last agricultural frontier was not generally realized at the time. But by 1914, when World War I commenced, it was becoming apparent.

Jack and Whyte estimated the following: *More food-producing soil was lost to the world by erosion alone in the twenty years between 1914 and 1934 than in the whole of the previous historical period! (Vanishing Lands*, p. 219.)

"During World War I, some fifty million acres of

agricultural lands in Europe, exclusively, went out of cultivation. Consequently, 40 million acres of grasslands in the United States were thrown into cultivation for the first time. This land — most of it in the area of western Texas and Oklahoma, extending into the bordering parts of Colorado, Kansas, and Nebraska — *never was fitted for intensive cultivation.*

"In the madness of the 'wheat rush' these lands were ripped open by the plow and wheat was cultivated on them by a process which is better described as 'mining' than agriculture . . ." (*Man and the Soil*, p. 49, emphasis ours).

On many of these huge farms there were no permanent residents. Men came in the fall or spring, plowed and seeded the soil, and went away. They returned in the summer, gathered the crop and went away again. After the harvest, the bare soil lay unprotected, as dry winds swept across it and the fierce sun baked it and robbed it of moisture and fertility.

Because of the richness of the soil, "Catastrophe did not come for several years. . . . When finally the one-crop system of spoilation had exhausted the organic matter, the land was ready for the great dust storms" (*ibid.*, p. 49).

In portions of the U. S. Plains States, Arizona and California, there are deserts where 50-100 years ago lush grasses reached up to the horses' bellies or higher, and bumper wheat crops were a yearly occurrence.

America Not Alone

The entire world joined the U. S. in this orgy of destruction. Deterioration of soil due to the unprecedented economic expansion of the nineteenth century was *worldwide.*

When the soil deteriorates, the effect is the same as a reduction in the amount of land. So while population greatly increased, the earth suffered a severe loss in her ability to feed her inhabitants!

According to Jacks and Whyte, Africa ranks even

ahead of North America in the extent and severity of depletion. General Smuts of South Africa once stated, "Erosion is the biggest problem confronting the country, bigger than any politics."

Although the data is fragmentary, virtually every nation in Central and South America suffers these problems to some extent. In many areas, such as the wheatlands of Chile and the pampas of Argentina, they are severe. Overgrazing and plowing up grasslands to grow wheat have taken a heavy toll in destroying the choicest agricultural lands on the continent. The Amazon Basin and other tropical areas — though of less value agriculturally — also show excessive erosion.

The story of topsoil depletion in the great Australian wheatlands and the grazing lands that border the great central desert sounds like a replay of what happened in the American West. Deforestation of mountains has also created a flood and siltation problem.

In the grazing country of New Zealand, there has been extensive deforestation to provide pastureland, which, in turn, has been heavily overgrazed. Many steep slopes that should have been left to permanent forest were cleared to accommodate more sheep and cattle.

Nor is it just the newer countries which are destroying their soil. Soil depletion is very extensive and acute in the great wheat-producing black lands of Russia and in the vast Eurasian grasslands. In India, too, this cancer has been spreading with startling rapidity as the population has increased.

Looking at the world's soils and natural resources in the large, they are in general and with few exceptions characterized by similar degenerative processes. Ward Shepard, writing in *Food or Famine*, classifies these as follows:

"1) In humid regions, water erosion is destroying sloping lands by virtue of poor methods of tillage and by overgrazing of pastures.

"2) The cultivable grasslands — the prairie soils of

the Americas, Australia, Africa, and Russia — are being depleted by one-crop farming, notably, wheat, and by wind and water erosion.

"3) Semi-arid grasslands in the Americas, Eurasia, Africa, and Australia have been severely devegetated by overgrazing, with intense wind and water erosion that in many regions is producing or threatening to produce true desert conditions.

"4) The bulk of the world's forests are being destructively exploited, not over 12 or 15 percent of the total forest area being under scientific management.

"5) In all these countries, poor tillage, overgrazing, and deforestation are wasting vast quantities of surface water by permitting it to rush into stream channels and out to sea instead of being absorbed into the soil by well-kept vegetative cover. This wastage causes desiccation of the land, the disruption of rivers and valleys, and in increasing menace to immense potential sources of hydroelectric energy."

The earth's total forest and grassland cover has already been depleted well below the safety margin for maintaining a healthy climate.

Assessing the Erosion Problem

"Erosion has modified the surface of the earth more than the combined activities of all the earthquakes, volcanoes, tornadoes, and tidal waves since the beginning of history, yet its processes are so gradual that we . . . have been prone to ignore it," Burges says in *Soil Erosion Control*, pages 3-4.

And ignore it men did!

It was not until the emergence of the United States Soil Conservation Service in 1933 that man "began to grasp the ominous magnitude and menace of man-made erosion as a world phenomenon" (*Food or Famine*, p. 8).

The seriousness of the situation was driven home by a series of calamities in the "form of searing droughts, stupendous floods, and continent-darkening

dust storms that impressed on men's minds, to the four corners of the earth, the fury of the swiftly spreading revolt of nature against man's crude efforts of mastery" (*ibid.*, p. 9).

And what did the Soil Conservation Service find when they made their first survey? They found that man-made erosion was in progress on more than one billion acres of land — more than half of the total acreage in the continental United States!

They found that already over 100 million acres of our best crop land had been irremediably ruined for further cultivation!

In addition, "An even more destructive and critically dangerous erosion has swept over the western grasslands of the Great Plains and inter-mountain plateaus after fifty or seventy-five years of overgrazing by livestock and futile and mistaken efforts to subdue these lands to the plow . . . . Nowhere in America and almost nowhere in the world is the stupendous breakdown of great land masses and river systems more advanced, and in few parts of the world has man been more decisively defeated by nature than in the grasslands.

"In the third great category of land — forest land — America has met the same decisive defeat at nature's hands" *(ibid.*, p. 9).

In spite of conservation efforts over the past 35 years, conservative government estimates indicate that *right now* nearly two thirds of the 1.5 billion acres of privately owned rural land in the U. S. (about three-fourths of the total land area) needs conservation treatment!

Estimated Annual Loss

The U. S. Soil Conservation Service has calculated that, "In a normal production year, erosion by wind and water removes 21 times as much plant food from the soil as is removed in the crops sold off this land."

Man-made erosion from America's farms and grasslands alone is moving over three billion tons of soil

Ambassador College Photo

Note that this average layer of humus-bearing topsoil is only about as deep as the little camp shovel, about eight inches. Many areas have much less topsoil.

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every year down into our rivers and reservoirs and out to sea. It would take a train of freight cars long enough to encircle the earth at the equator 18 times to haul away such an enormous quantity of earth!

That is a loss of one ton of topsoil for every man, woman and child on earth.

This is the rich topsoil that contains, in minerals and humus, the great reserves of plant food standing between man and famine!

On the basis of 100 tons of topsoil to cover one

acre seven inches deep, the equivalent of 10,000 one-hundred-acre farms are lost in the U. S. to water erosion down the Mississippi alone every year *(Soil Conservation,* p. 9). That is about two million tons per day!

"All of the rivers of the earth probably are carrying to the sea about forty times as much sediment as that carried by the Mississippi" *(The Illustrated Library of the Natural Sciences,* art. "Erosion").

What wind erosion can do was demonstrated by the unprecedented duster of May 11, 1934. It carried away an estimated 300 million tons of topsoil from western Kansas and parts of neighboring states. On the same basis as mentioned above, this one duster took the equivalent of 3,000 one-hundred-acre farms out of crop production!

All these figures, of course, must be taken only as estimates.

Erosion takes away the *prime materials* of the soil. Therefore, some experts believe the loss is far greater than is apparent from mere consideration of its actual weight or total quantity.

What is removed by erosion is the best part of the topsoil, the surface portion, which contains health-producing microbes, humus and finished plant food. The one ton of topsoil that each person on earth loses each year contains enough plant food to provide that person's sustenance for years. This all means, of course, that soil conservation and proper agricultural methods could make the whole earth fabulously rich.

The Loss of Water

The tale of wastage does not end with erosion. It also includes the mass of surface water which is lost as it sweeps the eroded soil seaward. Under normal conditions rainwater goes into the soil to nourish plants and to slowly feed wells, springs, ponds, creeks, and rivers. Man-made loss of surface water is desiccating the earth.

It is wasting and preventing human use of a substantial percentage of the total rainfall.

The full fury of the destructive process is seen in our great river systems. With their channels clogged and ever rising by the deposit of our wasted soils, our rivers are becoming more and more incapable of safely carrying away the increasing quantities of wasted surface water. More than 8,000 of the 12,711 small watersheds identified in the U. S. mainland — or 65 percent — have conservation problems needing a solution (U.S.D.A. Bulletin 263).

Yet our engineers still think that man can conquer nature. They dream of restoring our broken-down river systems by simply erecting gigantic flood-detention and silt-detention dams. What a pitifully naïve approach to the problem!

"All the river barriers, in the form of dams and dikes, that man can construct to repair the consequences of his own folly in raping the earth are puny compared with the cosmic forces of destruction he has unleashed over the land.

"The engineers ignore the fact that nature herself, violently reconstructing entire watersheds in an effort to cope with the surplus runoff, has carved over 200 million gullies in the United States" *(Food or Famine*, p. 11).

Further, because of nature's unconquerable power, "an estimated 2000 irrigation dams in the United States are now useless impoundments of silt, sand, and gravel" (from a speech "Can the World Be Saved?" by Dr. Cole).

CHAPTER TWO

THE GROWING TRAGEDY OF
SICK SOIL

ROBUST human health demands wholesome food. Wholesome food can come only from fertile and productive soil.

But just what IS this miracle we call soil? How does it work? What is its function in the cycle of life? This is basic knowledge we all should possess.

What Soil *IS*

Soil is an entire ecosystem composed of six parts: 1) air 2) water 3) solid minerals 4) dissolved minerals 5) organic matter — dead remains of plants and animal wastes, and 6) a vast community of living organisms. These all work together (when they are all present in proper balance) to perform very important functions. One major function is to provide a place in which plants can live and grow to give us food. Another, to act as a garbage processing plant that not only gets rid of plant, animal and human wastes and refuse from the landscape — but decomposes that unusable refuse and gives it back to us in a form that is usable and *beneficial* to produce more food and of better quality.

Fertile topsoil is by far man's most valuable and indispensable natural resource. It lies, as mentioned previously, at an average depth of seven or eight inches over the face of the land. In some few areas, this life-sustaining layer of earth may be several feet deep; in

Ambassador College Photo

many other areas it is considerably less than even seven inches.

The soil is not, as many suppose, a dead, inert substance which merely supplies mineral elements to plants and gives them a place to anchor their roots. A healthy soil is vibrantly "alive" and dynamic. It teems with bacteria, fungi, molds, yeasts, protozoa, algae, worms, insects and other minute organisms which live mostly in its top few inches.

This hive of living creatures in the soil, the eaters and the eaten, adds up to incredible numbers. The bacteria alone may range from a comparative few up to three or four billion in a single gram of soil. In good soil the bacterial matter, living and dead, may weigh as much as 5,600 pounds per acre.

The fungi may add up to a million in a gram of dry soil, weighing over 1,000 pounds to the acre.

It is estimated that about 95 percent of the roughly one million insect species spend part of their lives in the soil.

And then there is the humble earthworm. He is nature's plow, chemist, cultivator, maker and distributor of plant food. Rich soil easily supports a worm population of 26,000 per acre. The earthworm is so important to the soil that we have an entire article about "The Worm and You." A free copy is available upon request.

All this teeming soil life plays a vital role in keeping the soil healthy and building it up.

The soil is not solid. It is actually composed of billions of grains, or soil particles. These range in size from smaller than 1/2000 of an inch up to 1/12 of an inch in diameter. Each of these tiny soil particles is covered with a tight-fitting film of oxides, water and bits of organic matter, which provides a habitat for the teeming soil life.

The surface area of these particles is staggering. One ounce of soil can easily have surface areas adding up to 250,000 square feet — about six acres!

The organic matter is obtained from living and dead plants and animals, plant roots, green manure crops, animal manures, crop residues, fungi, bacteria, worms, insects, etc. This organic matter is broken down and decayed through the action of the complex mass of soil microorganisms and earthworms upon it. This digestive action produces organic acids which make minerals soluble. The most important product of this process is *humus*.

Why Humus Vital to Soil

The importance of humus cannot be stressed too strongly. The more humus a soil contains, the healthier it is. Here are a few reasons why:

When it rains, soils with humus soak up the water. Humus is so porous it can hold at least its own volume in water. A four-inch rain on humus-rich soil causes little or no runoff; one half inch on humus-poor land can cause erosion and some flooding in lower areas.

Humus improves the physical condition of the soil, supports the soil's organisms, increases permeability, improves aeration, stabilizes the soil's temperature and serves as a storehouse of plant nutrients.

Yet to do all this, humus need not be more than five percent of the topsoil in most instances.

Why Soil "Wears Out"

When minerals, organic matter and soil organisms are present and *in balance* for a particular type of soil, that soil is fertile and healthy. But all too often this balance is upset. How? By the serious depletion of organic matter and humus, due to improper cultivation practices, unchecked erosion, continued monoculture and failure to restore to the soil what the preceding harvests have taken from it.

Modern agriculture practices the substitution of synthetic fertilizers for humus that is not being replenished in the soil. The "replacing" of humus by arti-

ficial means does stimulate plant growth, but it also continues to upset the vitally needed balance and blended mixture of minerals, organic matter and soil life found only in humus.

Chemical fertilizers not only hasten the decay of organic matter and humus, but they also add only a part of the mineral portion of the critically important soil mixture essential to good health.

An unbalanced soil is not normally caused by a lack of minerals, as many believe. Even in relatively poor soils there is normally a large reserve of minerals.

What is most often missing is sufficient organic matter and the soil life which is necessary to break down the rock materials into food forms the plants can assimilate and use. Even mineral-rich soil usually lacks enough nutrients in available form for vigorous plant growth. Humus, then, is one key to soil balance and fertility.

Types of Fertilizers

True fertilization is the addition to the soil of materials conducive to increasing soil life and humus content. Fertilizers are generally recognized in two groups — organic and inorganic. The organic is basically made up of organic matter and microbes.

Inorganic fertilizers are basically comprised of minerals and are available in two major types. One type is made up simply of ground-up minerals as they are found in their natural state. This type of fertilizer is not generally immediately dissolved by water, but is gradually changed into plant food by the action of microbes, earthworms and organic acids that are formed by the decomposition of organic matter.

The other type of inorganic fertilizers are those easily soluble in water, causing corrosive action. These chemical fertilizers are manufactured products and are commonly advertised and sold on the market for quick results. Most farmers and gardeners use them, and feel they could not get along without them.

In nature there is no need for special fertilizers. Plants and animals live together, and their litter accumulates on the surface to compost and decay, thus making a health-sustaining, humus-rich soil. The whole life cycle in the soil becomes a self-regulating system as long as it is undisturbed by outside forces.

When man enters the picture, however, it becomes a different story. He plows up virgin land to grow crops. The soil condition made available by plowing stimulates the microorganisms into breaking down the organic matter more rapidly. Then man removes his crops from the soil, thus further taking from its reserves. When he has thus "mined" the soil until it can no longer produce profitably, he moves on — or at least he did until this century. Now there are no new lands to exploit.

Since 1880, it is estimated that about half of the humus in the Midwest has been lost — the loss greatly intensifying in recent years. The situation is probably equally bad or worse in many other heavily farmed regions of the world.

It doesn't have to be this way. With a little more effort and a lot less greed, man could return organic matter to the soil and build humus. But he seems to be hopelessly greedy and short-sighted. He would rather borrow from the soil's capital and ignore repaying this debt until necessity demands it. Necessity is now *banging* on the door!

Desperately, man is looking to chemical fertilizers to bail him out and to repay his debt to the soil. But is this possible? Can chemical fertilizers truly restore soil fertility?

No! Such was never intended.

How Chemical Fertilizers Became Popular

In the 1840's, von Liebig in Germany noticed the regular presence of certain mineral elements — especially nitrogen, phosphorus and potassium — in the ashes of burnt plants. Since these had to be drawn from

the soil, he concluded that soil fertility depended primarily upon the presence of these elements in the soil. He further suggested that fertility could be maintained or improved by adding these elements in suitable forms to the soil. About the same time an Englishman, Lawes, was experimenting along similar lines.

It was found that when nitrogen, phosphorus and potash were added to depleted soil, in the form of water-soluble chemicals, production was increased like magic! Soon farmers the world over were adopting this method as a shortcut to "soil fertility."

It should be noted that the early advocates of chemical fertilizers only intended that these fertilizers *supplement* the use of organic matter. For a time this continued to be the case.

For example, Lord Hankey, in a speech in the House of Lords when soil fertility was debated said: "There is more common ground to begin with in this matter than is generally realized. . . . There is common ground as to the great importance of humus in the soil. There is common ground also that, whether you have artificials or not, you must have an adequate supply of organic fertilizers. Again, compost is admitted by the supporters of chemicals to be a very valuable form of organic fertilizer. . . ."

In Lord Hankey's thinking — and the thinking of many others — chemicals were not intended to replace the function of organic matter, but to *complement* it — to help it feed crops.

But were these chemicals really *necessary?* Were they really *needed* to complement the organic matter?

There is no question whatsoever about the fact that humus-rich soil can provide everything needed to maintain and build soil fertility — including nitrogen, phosphorus and potassium (abbreviated NPK). But because of changing social and economic conditions, men found it much more expedient to provide plant nutrients by organic matter *and* chemical fertilizers instead of just by organic matter alone.

Intensive specialized farming became more and more popular. This method of farming, for the most part, does not allow for crop rotation and periodical planting of soil-building legumes. By this time, also, the internal combustion engine was gradually replacing the horse. There were labor problems with mass migration to the cities. Farm size was increasing along with economic pressures on the farmer.

And then there was industry. Astutely sensing big business, industry did not wait to be asked to provide artificial fertilizers to the farmer. Through intensive advertising it urged and "educated" the farmer into believing that artificial fertilizers were his panacea.

Under these conditions, the use of chemical fertilizers skyrocketed! Soon many farmers forgot about the need for organic matter and true soil building!

As a result, our husbandry has been invaded by pests, parasites and diseases; but industry, unashamed, has provided an arsenal of more than 50,000 chemical formulations to fight them.

What Chemical Fertilizers Do

Chemical fertilizers are like shots in the arm to the soil. They stimulate a much greater plant growth and a speeded-up consumption of organic matter and humus.

But, and never forget this, *chemical fertilizers can neither add to the humus* content nor replace it.

They do much more than just speed up the consumption of humus, however. They also destroy the physical properties of the soil and its life.

When they are put into the soil, they dissolve and seek natural combinations with other minerals already in the soil. Some of these new combinations glut the plant, causing them to become unbalanced. Others remain in the soil, many in the form of poisons.

For example, when sulphate of ammonia is used as a fertilizer, the sulphate is removed by hydrolytic action and eventually ends up in the water supply or as insol-

uble sediment in drainage reservoirs. Other chemicals used as fertilizers follow the same pattern and add various pollutants to our soil and water.

Further, manufactured fertilizers alone cannot supply what the soil needs to produce abundant, healthy crops. Plants need much more than NPK! They need many other secondary and trace elements — all in the proper balance. And they need the teeming microbial life that helps them absorb the minerals.

The margin between too much and too little is often very slight. Mineral excesses in plants — now common — are often more dangerous than deficiences.

Too much nitrogen weakens the plant. It grows lush and watery tissue, becomes more susceptible to disease, and the protein quality suffers.

There is no artificial fertilizer on earth that can supply a completely balanced diet for plants in the way that humus-rich soil can. Chemical fertilizer companies blend and formulate mixtures to the best of their ability, but they simply cannot mechanically formulate humus.

Plants were not designed to get their nutrients by being force-fed. Quoting soil scientist Eric Eweson:

"Even if we possessed sufficient knowledge and it were practical to provide chemical fertilizers containing some 20 or 30 elements in the infinitely varying proportions required by plants — instead of just NPK — this would not solve our soil problem. Forcing upon the plants immediately available food in the form of water-soluble chemicals, which they cannot reject but must absorb constitutes a bypassing of the soil's extremely important functions in relation to plant life and all other life, in the same manner as intravenous injections of sugar or protein bypass the digestive system of the human body. Neither can contribute to normal, vigorous life."

Nitrogen-fixing bacteria in humus-rich soil supply nitrogen to the plants as needed; they don't force-feed the plant like chemicals do. To force a plant to grow

more bulk will cause the plant to change its inner biochemistry. As Professor Albrecht of the Missouri Experimental Station has shown, more carbohydrates and less proteins will develop in such plants. Insects are out for unbalanced plants and find these a well-prepared table and a suitable diet.

As explained later, the purpose of insects is to remove weak and sickly plants so that quality can be maintained. The alarming increase in pests shows that something is wrong with an increasing number of our crops.

Laboratory tests have shown that seeds from plants grown on water-soluble nutrients are often incapable of germination. Even now many farmers cannot continuously use their own crops for seed because of poor germination. After a few years their seed stock "runs out" — as farmers express it — and they are forced to obtaïn fresh seed produced on better soil. Seed that cannot reproduce is certainly lacking something vital! Hybrid seeds are also a major big contributor to this problem.

Decline in Food Value

As crops are grown in humus-deficient soil with the aid of increasing quantities of chemical fertilizers, the crops become increasingly deficient in proteins, vitamins and minerals. This has been proved repeatedly by comparative analysis of grains, vegetables, and other products produced on humus-rich soil and on chemically fertilized soil.

According to Kansas surveys by the USDA between 1940 and 1951, while total annual state wheat yields increased during this period, protein content dropped from a high of nearly 19 percent in 1940 to a high of 14 percent by 1951. By 1969 the protein content of wheat had dropped to an average of 10.5% in the U. S. Midwest.

Protein content in corn and other feed crops have often dropped even more remarkably than in wheat. This is one reason farmers today have to feed larger quan-

tities of feed to livestock than they did in times past.

Plants must depend upon the available supply of minerals in the soil in which they are growing for the elements essential to their growth. Man and the animals he eats depend in turn upon the plants for these nutrients.

In other words, you are what you eat! If you eat foods which lack in nutritional value, your body pays the penalty. Plants and animals raised on eroded and depleted soil are inferior producers of foods. And such foods result in sick, degenerate and disease-prone human beings. It's just that simple — and that *sure.*

"The most serious loss resulting from . . . soil exhaustion," warns Mickey, "is *not quantitative, but qualitative.* It has to do with the quality of life the soil supports" (*Man and the Soil,* p. 33).

Soil lacking in calcium and phosphorus lacks the elements of proper bone growth of both animals and humans. Soils lacking in organically produced nitrates and other minerals produce vegetation lacking in the proteins essential to the building and repair of body tissues. It has long been known that animals raised on the world's choice limestone soils like those around Lexington, Kentucky, and Florida's uplands, for example, have stronger bones, sounder flesh, greater endurance, and longer lives than animals raised on soils less rich in bone and muscle-building minerals. That is why breeders of race horses in the U. S. have practically taken over the Kentucky bluegrass region and much of Florida's limestone land.

The same applies equally to humans. The baby won't have good bones if fed a formula made of milk from a cow whose feed came from a soil deficient in calcium and phosphorus. And the adult won't build muscle and good red blood by eating a steak from a steer fed on grasses and grain from leached and eroded soils devoid of protein-building minerals and iron.

"Much remains to be done in the study of the relationship of the soil to the mineral and vitamin require-

ments of human diet, but much has been done. And what is known points unequivocally to the fact that *deficient soils produce deficient men*" (*Man and the Soil*, pp. 3-4).

That is why the growing problem of soil depletion is so important to you!

Nitrate Pollution

In recent years another major problem has been developing as a direct result of chemical fertilizer use and the concentration of animal wastes. That problem is pollution of water, air and food by excesses of a form of nitrogen called nitrate.

Nitrogen, together with carbon, hydrogen and oxygen, are the four chemical elements that make up the bulk of living matter. But the nitrogen cycle, which vitally affects protein quality, is very vulnerable to human intervention. Today the nitrogen cycle in the U. S. is being thrown out of balance by two main factors: nitrogen fertilizers and nitrogen oxides from cars and other combustion processes.

More than 75 years ago research stations such as the Missouri Agricultural Experiment Station undertook long-term experiments to study the effects of different agricultural practices on crop yield and on the nature of the soil. When the 50-year Sanborn Field Study from Missouri was published in 1942, it showed that nitrogen was an effective means of maintaining good crop yields. But the report also showed that the soil suffered important changes.

The organic matter content and the physical conditions of the soil on the chemically treated plots declined rapidly. These altered conditions prevented sufficient water from percolating into the soil, where it could be stored for drought periods. A condition had also apparently developed in which the nutrients applied were not delivered to the plant at the rate needed for optimum growth. Most of the nitrogen not used by the

immediate crop was removed from the soil by leaching or denitrification.

This Sanborn Field Study, and others elsewhere, were a warning that in humus-depleted soil, fertilizer nitrate tends to break out of the natural self-containment of the soil system. But this warning was ignored. Today it can be ignored no longer.

Some seven million tons of nitrogen fertilizer are used annually in the U. S. alone — a 14-fold increase in about 25 years. Roughly half of this fertilizer leaves the soil in some way. Much is leached out and drains into water supplies.

In heavily farmed areas, the nitrate level of surface waters and wells often exceeds the public health standards for acceptable potable water, resulting in a risk to human health from nitrate poisoning. Also, when large amounts of nitrogen and phosphorous drain into surface water, they create an algal buildup that can and does destroy entire bodies of water. The oxygen in the water is depleted, causing fish and other animal life forms to die.

Excessive nitrates in plants cause similar problems. Some vegetable products in the U. S. exceed the recommended nitrate levels for infant feeding. Research indicates this is usually the result of intensive use of nitrogen fertilizer.

Some of the nitrate pollutants found in the nation's atmosphere also come from agriculture sources.

The nitrate problem is so serious that it cannot continue — *if we are to survive.*

This leads to the question of what can be done to solve the problems caused by chemical fertilizers. And more important than that, what can be done to solve the entire problem of decreasing soil fertility and its resultant effect on human health?

What Can Be Done

First of all, we must stop employing practices that have caused the problems and begin replacing them with

conscientious methods of cure and prevention. We must have open minds — minds willing to be reeducated, willing to admit error, willing to change.

Man needs to change his attitude towards the soil. Instead of only taking from it, we need to GIVE BACK to soil by replacing and building up the supply of humus. Basically this can be done through heavy green manure cropping and the returning of other organic material such as crop residues, animal manures, etc., to the soil. Details on building the humus supply are commonly available.

Animal waste in the U. S. alone is equal to the sewage of two billion people. It amounts to a billion tons per year! "Waste" is not really the right word, for these by-products of the life process are not to be wasted but carefully used to maintain soil fertility. Manure used to be carefully collected, composted and used on the land. Today its disposal is one of the livestock industry's biggest headaches. Instead of being a pollutant as in many instances it has become, it should be looked upon and handled as an asset and returned to the soil.

We need to make efficient use of all organic refuse. Why pollute our rivers and lakes with organic wastes when such material could be used to enrich the land?

Careful attention also needs to be given to soil ecology. The biological activity of the soil takes place somewhat in layers. If this layer-type activity is inverted the renewal and building process is interrupted. Therefore, tillage practices which invert and destroy the soil structure and soil life should not be continued. Manures and other organic material should be added to the soil's surface or mixed into only the very top few inches.

We must immediately embark on a *worldwide* soil restoration program. Our attitude and action towards the soil must change and return to sound principles if we are to reverse the present crisis.

CHAPTER THREE

HOW MAN CAN RESTORE

THE BALANCE OF NATURE

"CHEMICAL warfare" is a fact of life. It is, today, man's last arsenal against crop-destroying insects.

These chemicals affect not only insects but man himself. They affect everyone — and that includes you. No matter who you are or where you live, you consume, in your food, pesticides originally meant for insects. And you carry these chemicals around in your body.

More than a billion pounds of pesticides have already accumulated in the earth's air, water, soil, living plants and animals; and the amount grows daily.

What these poisons are doing to the entire web of life — and to personal health — is only beginning to be known. But what is already known ought to tell us that, unless we drastically change our ways, we are heading for disaster.

Life Chain Threatened

The most common of the pesticides are DDT and other chlorinated hydrocarbons.

These are especially vicious pollutants. They are very stable compounds and are not easily broken down. And because of their persistence, they cause dangerous biological concentrations in the food chain. They end up ultimately in the human body. Here is what happens:

Ocean water, for example, contains phytoplankton

Bob Taylor Photo

— the producer of over half the world's oxygen supply and the first link of the chain of life in the sea. Not only does DDT decrease oxygen-producing photosynthesis, but it has a tendency to be accumulated in biological organisms and passed up the food chain — from phytoplankton to zooplankton, shrimp, small fish, larger fish and then fish-eating birds. In birds the concentration may have accumulated an astounding 10 million times over the original amount present in the ocean water.

Likewise on land, these poisons are extremely destructive to microorganisms and other minute forms of life and life-processes in the soil.

Research on the subtle or long-range effects of chlorinated hydrocarbons is just beginning — especially in regard to man. But what is happening to birds and animals ought to sound the alarm.

Pesticides have virtually wiped out certain bird species by upsetting an intricate hormone-enzyme relationship which causes thin-shelled eggs that crack and fall apart easily. They have caused fatal nervous breakdowns in wildlife by interrupting the nerve communication system. Recent research indicates DDT causes a marked alteration in the sexual mechanisms of rats and a proneness to cancer in animals from mice to cattle.

Dr. Charles Wurster, one of the leading authorities on chlorinated hydrocarbons, says of these chemicals: "All are nerve poisons. They cause instability or spontaneous 'firing' of nerve cells, and increased doses result in tremors or convulsions — typical symptoms of acute poisoning that can occur in organisms ranging from houseflies to man. In general, if an organism has nerves, the chlorinated hydrocarbons can kill it" (*Weeds, Trees, and Turf*, August 1969).

Dr. Joseph J. Hickey, professor of wildlife ecology at the University of Wisconsin puts it bluntly: "DDT is a chemical of extinction."

Stanford biologist, Peter Raven, asserts: "There is

rock-solid evidence on what these chemicals do to other animals. It would be a bad mistake to think that man is unique."

As the harmful effects come to light, many around the world are beginning to speak out against the use of DDT and the chlorinated hydrocarbons.

Nerve Gases Used as Pesticide

In many areas, organic phosphors are being substituted for DDT and chlorinated hydrocarbons. These were originally developed in World War II as German nerve gases. Chemically, they are cousins to the nerve agents GD and VX, involved in the current chemical and biological warfare controversy.

Some fifty million pounds of organic phosphors are being spread unchecked as pesticides on America's farms and gardens annually.

Because these pesticides break down much more quickly than chlorinated hydrocarbons, many assume they are safer. The truth is that these odorless and colorless chemicals are potentially even more dangerous.

Dr. Alice Ottoboni, California State Public Health Department toxicologist, says of organic phosphors: "As a class, they are more immediately harmful to man and animals than the persistent ones." Minute amounts can kill almost instantly either by contact or by being swallowed.

Also, a nonpersistent pesticide does not just "disappear." As it breaks down "it becomes another chemical that may be less or more toxic than its parent," warns Dr. Ottoboni. Very little is known of the environmental fate of these degraded products of pesticides, either persistent or nonpersistent.

The distressing fact, in addition to the ecological problem, is that pesticides have not eliminated insect infestation. Though we have increased pesticides enormously, more than seven times over in the past 20 years,

crop losses due to insects remain about the same. Presently, USDA figures show about 1/5th of our crops are lost to insects.

Another major problem with using pesticides is that natural enemies of the pest are often killed along with the pest. Since these natural enemies were partially successful in controlling the pest population, wiping them out temporarily leaves the pest free of important natural restraints. Under these circumstances, the pest will develop a resistance through mutation and again multiply before the natural enemies can multiply to control them.

Thus resistance of insects to pesticides is a mounting worldwide problem. Between 1908 and 1945 only 13 species of insects had developed resistance. Now the figure stands at almost 150!

The current practice employed to control these new hardy pests is to develop a new, more potent pesticide. Instead of controlling or killing the insect pests, a vicious cycle is created — stronger insects, more toxic pesticides and an increasing threat to all life forms on this planet.

No Way Out?

Here then is our dilemma: We are told that if pesticides were completely withdrawn from use, crop and livestock production would drop from 25 to 50 percent — that commercial production of apples, peaches, cherries, grapes, cranberries, raspberries, strawberries, citrus and a host of other products would come to a halt — and that millions would have their diet drastically altered or reduced.

Yet, there are numerous cases of farmers who have stopped using insecticides and have done better than their neighbors who continued to use poisons.

If we continue to use pesticides we will be in deep trouble.

Not only will pollution reach critical proportions,

but as insects develop resistance faster than new pesticides can be developed, it is just a matter of time until these insects will begin to destroy food crops wholesale. And mankind will be utterly unable to stop them.

Some look to biological control to provide an out. But so little money and effort is being spent on research in this area — and progress comes so slowly — that this appears to be a false hope. In addition, there are whole categories of pest problems with no remote prospect of biological control.

Have we then painted ourselves into a corner? Is there no way out? Is there no way that insect plagues can be stopped without using pesticides?

The surprising answer is that there IS a way out.

Let's begin to explore what the solution is by asking some very basic questions — and finding some very simple, yet profound answers.

Do insects have a purpose? What causes insects to attack plants and become "pests"? Few seem to know.

The Purpose of Insects

Insects constitute 70 to 80 percent of all animal species. They are so numerous that no one knows how many species there really are. More than 800,000 have already been classified and 10,000 more are being classified annually. There are almost as many insects on every square mile — three billion — as there are humans on earth.

Insects multiply rapidly. A single pair of flies is potentially capable of producing 191,010,000,000,000,000,000 offspring in just four months! If they all survived, the earth would be covered to a depth of 47 feet!

This cannot happen, because the laws governing nature never permit a single species, plant or animal, to dominate any environment completely. Weather factors

— such as temperature and rainfall — limit the distribution of an insect species. Toads, lizards, frogs, moles, snakes, birds, bats, shrews and other creatures feed largely on insects. Some birds eat their own weight in insects every day. Predatory insects prey on other insects. Larvae of parasitic insects develop in the eggs, the young or the adults of other insects. Viruses, fungi and bacterial diseases also help control the insect population.

In fact, if the insects were not kept in check by these natural forces, it is doubtful whether any conceivable volume of chemicals could possibly keep down their populations. Yet we are seldom aware of nature's own controls.

All these natural checks do their work without threatening man. Insecticides, which contribute only a very small part of the total controlling force over harmful insects, are threatening all life. Doesn't it make sense for man to encourage the balance of nature rather than devastate nature's natural controls at every turn?

It is not generally realized that *less than one percent* of the insect species are considered pests to man. We can figure the crop loss due to these pests with a fair degree of accuracy (about $4 billion annually in the U. S.). But the positive benefits of insects are often overlooked because they are more difficult to estimate.

It is easy to forget that bees, wasps, flies, butterflies and other insects pollinate plants that provide us with fruits and vegetables; or that some insects are vital links in the food chains of fish, birds and land animals; or that others act as scavengers of animal and vegetable debris and others as aerators of soil; or that still others are parasites or predators of damaging insects.

Instead of studying the habits of insects and implementing natural control methods, many now simply mow them down with spray guns.

For the most part, the function of "harmful"

insects is all too little understood. Now, happily, some few scientists are beginning to realize the relationship between soil fertility, crop production and pests.

Why Insect "Pests"?

In his landmark book *An Agricultural Testament*, the famous British agriculturist Sir Albert Howard relates how in five years' time at a research station in India he "had learnt how to grow healthy crops, practically free from disease, without the slightest help from mycologists, entomologists, bacteriologists, agricultural chemists, statisticians, clearing-houses of information, artificial manures, spraying machines, insecticides, fungicides, germicides, and all the other expensive paraphernalia of the modern Experiment Station." In other words, Sir Albert worked with the principles any small farmer could use economically.

From his experience, he observed that: "Insects and fungi are not the real cause of plant diseases but only attack unsuitable varieties or crops imperfectly grown. Their true role is that of censors for pointing out the crops that are improperly nourished and so keeping our agriculture up to the mark. In other words, the pests must be looked upon as Nature's professors of agriculture: as an integral portion of any rational system of farming.

"The policy of protecting crops from pests by means of sprays, powders, and so forth, is unscientific and unsound as, even when successful, such procedure merely preserves the unfit and obscures the real problem — how to grow healthy crops" (p. 161).

These conclusions are not dreams of a man who failed. Sir Albert was knighted for these very agricultural researches — for effectively proving the usefulness of the system.

Many who have worked with the soil have noticed the tendency of insect pests to prefer plants that are

weak, sickly, unhealthy, unbalanced or just a little "under the weather."

This deficiency or imbalance may be so subtle or so slight that it cannot be measured or analyzed by present scientific methods. Because science cannot ascertain this imperfection — and, judging by the paltry amount of research being done in this area, is not interested in finding out — it usually pretends that no imperfection exists. But it *does* exist. And the bugs know it!

Now take the cause-effect relationship a step further. What is it that causes plants to be weak and inferior — prone to insect attack?

Why Inferior Plants?

A number of factors may cause weak and inferior plants. But one of the most important factors is a depleted or unbalanced soil.

A professional soils consultant for Brookside Laboratories of New Knoxville, Ohio has stated: "We are proving today that sick soils produce sick plants and sick plants produce sick animals and humans. There are about one hundred of us who work with about 10,000 farmers at the present time. The overwhelming majority of them have already discovered that in a *truly healthy* soil our crops are not attacked by insects because God created these pests to destroy sick plants so that they cannot reproduce themselves."

In times past, this interrelationship of soil, plants and insects was recognized. In 1870 the American journalist Horace Greeley reported: "Multiplication of insects and their devastations are largely incited by the degeneracy of our plants caused by the badness of our culture. I presume that wheat and other crops could not be devastated by insects if there were no slovenly, niggard, exhausting tillage methods used. But when the fields of western New York were first tilled there were few insects; but after crops of wheat had been taken from those fields until they had been well-nigh

exhausted of crop-forming elements, we began to hear of the desolation wrought by insects."

Mr. Greeley had understanding that most seem to lack today. In this day and age ever so few see any relationship between our depleted soils, the use of incomplete synthetic fertilizers and the alarming increase in insect pests.

It is to their great shame that most agricultural institutions have been preoccupied with research involving palliatives such as pesticides. They have utterly neglected research into how to correct the CAUSE of insect pests.

The information gleaned from the smattering of work that has been done, however, bears out the validity of the principles just presented.

Dr. William Albrecht of the University of Missouri showed that spinach grown in fertile soil resisted the attack of thrips, while that grown on poor soil was destroyed by these insects.

Dr. Leonard Haseman, also of the University of Missouri, found that the greenhouse white fly attacked tomatoes only where there was a phosphorus or magnesium deficiency in the soil. Chinch bugs thrive and multiply where corn is grown under conditions of nitrogen deficiency such as on eroded and poor hillsides *(Journal of Economic Entomology*, Feb. 1946).

Work done at the University of Florida shows that both the rate and the source of nitrogen have a pronounced effect on the susceptibility of grass to chinch bug damage. Grass receiving high rates of inorganic nitrogen was severely damaged by the bugs, in contrast with the grass receiving nitrogen from an organic source (Florida Turf Grass Association Bulletin, Fall, 1962, under title, "Chinch Bug Damage and Fertilizer," by G. C. Horn and W. C. Pritchett).

The Haughley Research Farms in England, operated over four decades, now under the world-renowned Soil Association, have found in actual practice that crops grown on soil built up by natural manures were

much more resistant to pest-inviting weaknesses than crops grown with the aid of chemicals.

We are observing the same result in our Ambassador College Agricultural Research Program.

Even under the best conditions, insects may destroy a small percentage of the crop. But is this in itself *bad?* The loss of the weakest part of the crop assures the food value of the remaining part.

You would think that the prospect of growing quality products which resist insects and render pesticides unnecessary would cause great excitement.

But not so. This solution — the only REAL solution — runs counter to the greed of human nature and the vested interests of our social and economic system. And it appears that man would rather perish than change *that!*

Monoculture Upsets Natural Balance

In the natural state, the earth always raises varied crops. But in some areas of our modern world, it is a rare sight to see mixed-crop cultures.

Yet it is well known that growing plants in large tracts of uniform crops is not natural and will attract abnormal amounts of insects. The greater the area under one crop and the extent to which that crop is grown exclusively year after year, reducing soil quality, the greater the potential insect problem.

The Colorado beetle is an example of what happens when man begins to simplify agriculture and farm one crop exclusively. This beetle used to be harmless, feeding principally on smart weed, which it hunted out from among many other plants. When huge fields of potatoes were newly introduced to Colorado, however, the beetle suddenly found itself in the midst of mile after mile of green potato fields — a beetle's "paradise." As a result, this beetle multiplied so rapidly that within a few short decades it literally ate its way 2,000 miles to the Atlantic coast!

Similar examples could be repeated many times from all parts of the earth.Yet unfortunately, our entire

modern farming method is geared toward extensive crop monoculture. To many it would be unthinkable to even suggest that this practice be changed! Yet many have successfully changed of their own free will.

Other sound principles of agriculture which farmers often neglect are the failure to rotate the crop to minimize insect reproduction; or to observe the correct time for planting; or to grow trees and hedges which encourage insect-eating birds to visit the farm.

Weeds and Herbicides

Herbicides to kill weeds are another major segment of the poison-spray pollution problem in agriculture. In the U. S., crop losses from weeds equal the combined losses from insects and diseases and run second only to those caused by soil erosion. American farmers lose about $2.5 billion annually to weeds and spend another $2.5 billion *fighting* weeds.

Discovery and exploitation of herbicides — weed killers — has been both rapid and recent. About half of the present commercial herbicides were unknown ten years ago! Some experts predict the number of herbicides will double in the next ten years and perhaps double again in the following decade. So we see here the same vicious cycle as with the pesticides.

The Purpose of Weeds

As with insect pests, few seem to realize that weeds have a purpose. In the preface to his book *Weeds, Guardians of the Soil*, Joseph Cocannouer lists some of the purposes of weeds:

> 1. They bring minerals, especially those which have been depleted, up from the subsoil to the topsoil and make them available to crops. This is particularly important with regard to trace elements.
>
> 2. When used in crop rotation they break up hardpans and allow subsequent crop roots to feed deeply.
>
> 3. They fiberize and condition the soil and provide a good environment for the minute but important animal and plant life that make any soil productive.
>
> 4. They are good indicators of soil condition, both as to

variety of weed present and to condition of the individual plant. Certain weeds appear when certain deficiencies occur.

5. Weeds are deep divers and feeders, and through soil capillarity they enable the less-hardy, surface-feeding crops to withstand drought better than the crop alone could.

6. As companion crops they enable our domesticated plants to get their roots to otherwise unavailable food.

7. Weeds store up minerals and nutrients that would be washed, blown or leached away from bare ground and keep them readily available.

Obviously, these purposes and benefits are listed only as general guidelines and do not apply to all weeds under all conditions.

F. C. King in his book *The Weed Problem: A New Approach* also reveals that weeds build up and protect the soil and, coexisting with domestic crops, can help make soil nutrients available to these crops. This author states that we are "hopelessly wrong in believing weeds to be useless plants and in devoting our energy to their suppression, instead of studying to employ them" (p. 17).

In England it has been reported that when lawns become deficient in lime, daisies appear. The daisies are found to be rich in lime, which they manufacture in their tissues. The lime goes into the soil when the daisies die and decay. When the soil becomes sufficiently enriched with lime, the daisy "problem" disappears.

When weeds become so abundant that they interfere with crop production, it ought to be recognized that the *cause* of the problem is not the weeds, but the depleted soil which the weeds are trying to protect and build up. Instead of destroying such weeds wholesale with herbicides while our soil continues to be degraded, we need to get busy and build up the soil so the weeds will naturally reduce themselves.

Solving the Problem

Here, then, is where we stand in regard to the pollution problem caused by pesticides, herbicides and such chemicals.

Is it possible to survive if we continue to use ever stronger chemicals in ever greater quantities? No!

Is it possible to survive if we quit using pesticides? Yes! Many farmers — large and small — are successfully doing it!

Will this be easy? For many, NO! This is because the solution to the problem is to restore *natural* fertility to the soil. And as Professor Cocannouer has well stated:

"Bringing a piece of land back to permanent fertility is probably the most difficult of all farm operations. Too often the farmer fails to make a go of his soil building because he doesn't acquaint himself thoroughly, before starting, with all the adverse factors he is going to have to fight. He gets discouraged because he does not see the size of the job of remaking land that has been weakened for fifty or a hundred years. He has more than likely been schooled to expect the quick response that land makes to stimulants. He forgets that now he is building for permanency, not merely stimulating."

Obviously the biggest hurdle will be changing our attitudes and accepting the fact that the way to success is to WORK WITH natural laws, NOT DEFY them.

Huge tracts of monoculture would have to be broken up and planted into smaller fields on a crop rotation basis. Because natural farming methods involve more intensive care that can often be given only by human hands, many millions from our crowded cities would eventually need to move back to the land.

A crash program in research and education to natural methods would have to be carried out immediately — and administered by the highest-level governmental agencies — in order to make a successful transition on a national level.

CHAPTER FOUR

AN EXCITING PREVIEW OF

AGRICULTURE in TOMORROW'S WORLD

A DRAMATIC revolution in agriculture *is* just around the corner!

It will produce far-reaching breakthroughs in food production and prosperity that will stagger the imagination. It will deeply and directly affect the life of every living person in every country on earth.

Here is an exciting glimpse into some of the tremendous — and wonderful — changes that will occur.

Agriculture's Fantastic Future

Vast new acreages of fertile, well-watered land will become available for growing crops and raising livestock. Perfect weather and bumper crops will be the rule — not the exception.

Hunger and malnutrition will be a thing of the past. Everyone in every land will be able to enjoy fresh, clean, wholesome, tasty, nutritious food — grain and nuts, meat and dairy products, and fruits and vegetables in unbelievable variety and abundance.

A large percentage of the world's populace will live on very prosperous family-sized farms. Millions of well-kept farms with spacious, beautiful homes will dot the landscape. Farm families will enjoy stable economic

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prosperity, radiant health, and a sense of satisfaction, accomplishment and fulfillment from their work.

They will strive to work in harmony with nature and the laws of God in every aspect of their farm operation. Farming will be a respected occupation and farmers will take pride in what they produce. Their goal will be to produce food that is high in *true quality* — not just a lot of bulk.

This means that careful attention and hard work will be given to building up the land. Natural methods of composting and fertilizing will be used to produce a healthy soil rich in humus and soil life — a soil whose produce will be practically impervious to insect plagues and disease. This fertile soil will be protected and further built up by proper tillage methods, diversification, crop rotation and other conservation practices. Such carefully managed soil will make maximum use of available moisture. It will not be plagued with erosion and a troublesome amount of weeds.

Instead of soil-depleting one-crop farming — with its corresponding price-depressing surpluses — farmers in Tomorrow's World will raise a large variety of crops. These crops will be carefully planted at the right time on the right soil.

Pesticides and other harmful chemicals will, of course, be totally unnecessary. Forcing the soil by means of artificial fertilizers, which produce yields of inferior quality, will simply not be permitted.

Healthy Livestock and Poultry

Since animals play an important part in the ecology of the life cycle, tomorrow's farms will have a *variety* of poultry and livestock. Most of these farm animals will be allowed to roam freely over rich pastures. Animal wastes will be properly used to make an important contribution to soil fertility.

Though livestock may be temporarily penned up for fattening purposes, they will not spend most of their

lives confined in crowded feedlots. Neither will chickens spend their lives cooped up in cages so small that they can barely turn around.

These farm animals will *not* be given a host of drugs and shots, and feeds of unnatural, unbalanced, highly concentrated mixtures that cannot possibly produce high-quality meat. Rather, poultry and livestock will be given feed and forage that is clean, balanced and high in natural nutritional value. This wholesome feed will produce strong and healthy stock that will reproduce robust offspring of the same high caliber.

Selective breeding of both plants and animals will be practiced — but only to build up factors of true quality. Development and use of inferior hybrid strains will not be permitted. Neither will there be such practices as artificial insemination.

Gracious Living for the Farmer

The high quality evident in the farm produce will also be reflected in the personal life of the farmer and his family. There will be hard work, but it will be challenging and rewarding. And farm life will not be a humdrum existence of toil and sweat from dawn to dusk with no time out for culture, relaxation and enjoyment of life.

In Tomorrow's World the farm family will have better opportunity for personal improvement, education, recreation, travel and socializing. Then all farmers will be intelligent, educated, cultured individuals — in a profession looked up to by the rest of society. They will have a goal in life other than seeking how they can squeeze another dollar's or pound's worth of produce out of the land.

Nearby cities will offer a rich variety of cultural, recreational, educational and social activities for the farm family. And scenic areas and parks of natural beauty will be available for hiking, boating, camping, fishing, etc., just a few miles away.

Society will be agriculturally oriented in Tomor-

row's World. Farming will be so popular that even city dwellers will want to take part in it. But not in the way so many do today when they "play at" farming to gain tax benefits.

Rather, people in tomorrow's cities will want to have their own gardens and small orchards just for the pleasure of working with the soil, of being close to nature and of growing a part of their own food. Because of changes in tomorrow's urban areas many people in towns and cities will have room for small-scale agricultural activities. Some will even keep a few chickens, cows, sheep or goats!

But how will this wonderful world of agriculture come about? Will it be by man's achievements in agricultural science and technology? Let's look and see what man has planned for the future of agriculture — and see how it compares with the future just described.

Agriculture 2000 A.D.?

"The efficient farmer of the year 2000," says an impressive study entitled *Agriculture 2000*, "is a super breed of farmer, with super skills and super tools. The heart of his operation will be a control center equipped with a wide array of electronic wizardry to help him produce crops two to five times as abundant as today."

The report describes unmanned tractors that are controlled by computer tape, buried wires or sensing devices. The courses of these tractors would be plotted on headquarter units similar to radar sets which follow today's airplane flights.

Other new machinery projected by the report are huge four- or six-wheel-drive tractors powered by electric drive, fuel cells or efficient storage batteries. Cabs would include air conditioning, food warmer, coffee maker, refrigerator, television, and even a sink.

Plant growth is expected to be automatically recorded, and simply by turning a dial the farmer will provide proper light, water and nutrients.

Production of cows' milk is predicted to quadruple. Man even plans to manufacture "identical" milk from carrot tops and pea pods. New varieties of corn will produce plants that look more like small pine trees! Fertile ova will be transplanted from superior cows into common incubator cows, allowing a superior cow to mother as many as 1000 calves in her lifetime.

The report foresees staggering production figures. It predicts yields of 300 bushels of wheat per acre, compared with today's 27; 175 bushels of soybeans, compared with 25; 30 tons of forage, compared with three; 30,000 pounds of milk per cow, as compared with 8,000; and 1000 pounds of beef at 10 months of age, compared with 750 today!

And how are these staggering production figures to be achieved? By the three magic wonders of modern agriculture: greater mechanization and automation, greater use of chemistry, and man-manipulated genetics.

Chemical Care From "Cradle to the Grave"

Today many farmers feel they could not survive without chemical pesticides and fertilizers. But we are told that the intensive use of chemicals in agriculture is just beginning, compared with the future. Not only will chemical pesticides be used with greater efficiency and precision in eliminating pests, and not only will chemical fertilizers become more refined and powerful, but scientists now envision "cradle-to-the-grave" chemical regulation of plant growth, development, yield and quality! It may surprise you to learn that the following plant processes are either presently under control or are being experimented with to come under such control:

Root initiation and development, speeding up or slowing down germination, whichever is desirable; control of vegetative growth and form of the plant so it can be accommodated by "once-over" mechanical harvesting.

This control involves regulating the branching and leaf orientation, the time of flowering and fruit set, the

color and enlargement of the fruit and the control of fruit ripening. It includes abscission control, which prevents the premature dropping of fruit yet loosens the fruit to make mechanical harvesting easy.

Artificial lighting and automatic feeding have already become widespread in livestock and poultry operations. Experiments with controlled environments show that all animals have a "comfort zone" and that temperature and humidity exert a marked influence on performance. Man hopes to raise livestock of the future in controlled environments (some even predict in high-rise, apartment-like dwellings!) and feeding is planned to be computer-programmed to meet specific needs. Estrus (sexual excitement) will be synchronized, and ovulatory rates regulated with the ova being fertilized artificially with sperm of known genetic material.

With chickens, an effort is being made to break through the egg-a-day barrier. It is reasoned that the hen should not have to act as a packaging machine and be required to produce a limestone container for each egg. If the shell could be discarded and if only the "membrane envelope" were produced, much of the time and energy now used in egg production could be eliminated. Such shell-less eggs already constitute more than 5 percent of the market!

Hogs that will be marketed in 100 days from birth and beef animals that will be marketed in six months are other predictions. The goal here is to get as much gain from every pound of food being fed as possible. One experiment with caged piglets produced close to one pound of gain for one pound of food!

As of 1969, *plastic* roughage went on the market for cattle! This product stays in the rumen and provides a "scratch factor" needed for efficient digestion of grain and supplement. It "eliminates" the need for natural roughage and in some instances has even increased feed conversion by 10 percent!

The recycling of animal wastes as reconstituted foods for livestock and poultry is another trend that is

catching on fast. This accomplishes two purposes: It gets rid of the waste, and it provides cheap feed.

This is the kind of agriculture *man* has planned for the coming years. But something is *terribly* wrong with this projected picture overall.

Modern Agriculture Is Failing!

The biggest problem in the glowing predictions we have just read is that there is NOTHING *which can quickly, practically, cheaply and effectively be put to work in solving our race with worldwide famine!*

Projections may *sound* good. Some may even come to pass in carefully controlled experiments or on small acreages in rich countries like the U. S. But this is a far cry from having the capital and skilled manpower to be useful on a large scale.

Besides, too often the glamorous-sounding projects deal with relatively minor factors as far as food production is concerned. The really BIG problems of shrinking available arable land through erosion, salt destruction and urban development, a sinking water table, and the continuing general worldwide decline in soil fertility are almost totally ignored. Little or nothing is being done to solve these *major* problems. In fact, the modern practices mentioned previously are all too often *hastening* the destruction of these priceless resources.

Just look at the *end result* of many of the "successful" practices of modern farming, such as chemical pesticides and fertilizers, drugs, antibiotics in feeds, hybrids, etc.

The truth is that every one of these practices is largely *at odds with nature.* Thus they are *breaking laws* which exact penalties. Because the penalty does not always immediately appear — at least not in its fulness — it is too often assumed that a penalty does not exist. But a delayed penalty simply means that the disastrous effects are accumulating and will in due time be released in full fury. Some of these unnatural practices may

appear to be successful — until we start to reap the penalty.

Pesticides and fertilizers, for example, have been hailed for contributing to greater yields and an increased food supply. But they also have been quietly and steadily killing soil life (earthworms, beneficial bacteria, fungi, and other organisms), causing erosion and pollution, and producing inferior food that is bringing sickness and suffering to mankind. The widespread evils of DDT, as only *one* example, are just beginning to be recognized by governments around the world.

When soil begins to show signs of depletion, it ought to be rested and carefully built up. Chemicals just *mask* the problem while they continue to further deplete the land.

Inferior quality is also evident in many new strains of plants. The widely hailed varieties of rice such as IR-8, for example, not only need huge amounts of chemical fertilizers and water, but they are also very highly susceptible to disease.

Our stock is likewise in a very precarious position. Feeds containing antibiotics have taken away from the animals their *natural* capacity to resist disease. Veterinarians warn we are "flirting with a tragedy" in this area. Now it is feared this lack of resistance may be transmissible to humans via the meat we eat.

We know of feedlots where the animals have been so doped with drugs and concentrated feeds that the *manure* of these animals will not even decompose! The producers try to solve this problem by *feeding the manure back to the animals!*

Money-Motivated

An estimated 85 percent of American cattle are given stilbestrol — "Queen of the Hormones." It has been known to cause lower carcass quality, prolapse of the rectum and blockage of the urinary tract in cows. It lowers the grade of the carcass and gives the meat a watery, mushy appearance. It is *suspected* of being a

causative factor in cancer and the appearance of female characteristics in men who consume the beef so treated. Why is it used? Because 16 cents worth of stilbestrol can bring up to twelve dollars worth of profit!

Even mechanization and automation can be bad when taken to an extreme or improperly used. Mechanization has greatly speeded up man's ability to abuse the earth. The moldboard plow, for example, has helped convert far larger acreages into deserts than man has managed to transform into productive farmlands.

Neither is it good to coop up thousands of chickens in small cages so they can be automatically fed and watered at the expense of the birds' health and where disease could quickly wipe out the entire flock.

A disease of epidemic proportions in many areas not long ago killed tens of thousands of laying hens in just such poultry operations. The resulting egg shortage and increased expense in securing eggs from greater distances was reflected in higher prices to the consumer. These money-motivated practices often *cost* money!

And then there are the social and economic consequences of modern agriculture. The cost-price squeeze is one of many factors which drives many small farmers off the land into already-overcrowded cities to try to eke out an existence there. While the big farmers squeeze all they can out of the land, the cost-price squeeze is also slowly but surely closing in on them.

In utter incongruity, the government pays for taking some cropland out of production to relieve the surplus, meanwhile the farmer tries as hard as he can to produce more by forcing as much as possible from his remaining land so he can make a living!

And all the while agri-business debts pile higher and higher. Farmers are forced to take out ever-bigger loans until they owe the bank or other lending agencies their entire assets.

And in the underdeveloped, hungry countries? There the limited agricultural resources (and almost all

fertilizer) are used to grow cash crops such as coffee, peanuts, etc. These products are then exported to get foreign currency. Meanwhile the local people suffer from malnutrition and hunger.

Human Nature — A Basic Problem

Throughout history, man has cut down the forests, overgrazed the grasslands and mined the earth's croplands — with hardly a thought given to replacing, rebuilding and restoring. With very few exceptions, land *use* has been synonymous with land *abuse.*

And what has been at the root of this abuse? Human nature! An attitude of getting! Man's nature of vanity, jealousy, lust and greed manifests itself in every one of his activities — and agriculture is no exception.

The obvious problems of agriculture today cannot be solved unless and until man's nature of getting can be replaced by a nature of giving. As long as human nature with its tendencies to tear down, exploit and destroy is allowed to dominate, there is no hope for agriculture — nor to feed the malnourished, hungry and starving masses of our world.

A world-ruling government is direly needed to educate humans to proper farming practices and where necessary to *authoritatively* change our present agricultural ways.

And — believe it or not — very soon, now, a strong WORLD GOVERNMENT is going to be established. But not the way *men* seem to think. The WHOLE WORLD is going to learn the right way to farm — the right way to live — the way to abundance and happiness.

Entire Society Agriculturally Oriented

In the new world the nations "shall beat their swords into plowshares, and their spears into pruning-hooks: nation shall not lift up sword against nation, neither shall they learn war any more" (Micah 4:3).

Instead of making instruments of destruction and

being a war-oriented society, men will make instruments of peace, and society will become agriculturally oriented. Agriculture will be a respected profession, and many, many people will be engaged in it.

"But they shall sit every man under his vine and under his fig tree; and none shall make them afraid: for the mouth of the Lord of hosts hath spoken it" (Micah 4:4).

Because proper care of the land involves work which can often be done only with human hands, the farms in Tomorrow's World will probably be relatively small.

Can you imagine what it will be like when man wholeheartedly works in harmony with all of God's physical and spiritual laws? The results will be breathtaking. The Bible describes it in these terms:

"Therefore they shall come and sing in the height of Zion, and shall flow together to the goodness of the Lord, for wheat, and for wine, and for oil, and for the young of the flock and of the herd: and their soul shall be as a watered garden; and they shall not sorrow any more at all" (Jer. 31:12).

"Behold, the days come, saith the Lord, that the plowman shall overtake the reaper, and the treader of grapes him that soweth seed, and the mountains shall drop sweet wine, and all the hills shall melt . . . and they shall plant vineyards, and drink the wine thereof; they shall also make gardens, and eat the fruit of them" (Amos 9:13-14).

Yes, there IS fantastic *hope* for the future! There is wonderful GOOD NEWS that lies ahead. There *will* be NO famine, no malnutrition or hunger in TOMORROW'S WORLD.

If you want to learn more, and would like to know how you can have a part in it — write immediately for our FREE booklets: *Famine! . . . Can We Survive?* and, *The Wonderful World Tomorrow — What It Will Be Like.*

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